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We claim:

1. A supported catalyst for olefin polymerization comprising

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A) as support material, a copolymer comprising at least the monomer units I, II and III,

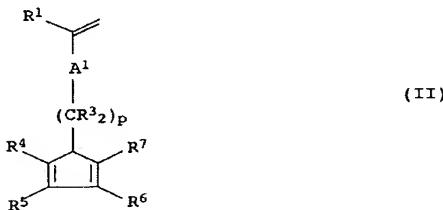
10 where the monomer units I have the formula (I) and the monomer units II have the formula (II),

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where the variables have the following meanings:

R<sup>1</sup> is hydrogen, C<sub>1</sub>-C<sub>4</sub>-alkyl or phenyl,

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R<sup>2</sup> is substituted or unsubstituted aryl or branched or unbranched alkyl or alkenyl,

A<sup>1</sup> is a direct chemical bond or a substituted or unsubstituted phenylene group,

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R<sup>3</sup> are identical or different and are each hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl or substituted or unsubstituted phenyl,

p is an integer from 0 to 8, and

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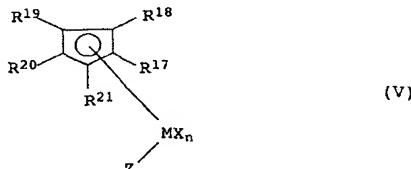
R<sup>4</sup> to R<sup>7</sup> are hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl or substituted or unsubstituted phenyl,

5 and the monomer units III have polar groups,

and

B) at least one metallocene complex of the formula (V)

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where the substituents and indices have the following meanings:

20 M is titanium, zirconium, hafnium, vanadium, niobium, tantalum or chromium or an element of transition group III of the Periodic Table and of the lanthanides,

25 X is fluorine, chlorine, bromine, iodine, hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl radical and from 6 to 20 carbon atoms in the aryl radical, -OR<sup>22</sup> or -NR<sup>22</sup>R<sup>23</sup>,

30 n is 1, 2 or 3, where n corresponds to the valence of M minus 2,

35 where

40 R<sup>22</sup> and R<sup>23</sup> are C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl, alkylaryl, arylalkyl, fluoroalkyl or fluoroaryl, each having from 1 to 10 carbon atoms in the alkyl radical and from 6 to 20 carbon atoms in the aryl radical and

45 the radixals X are identical or different,

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R<sup>17</sup> to R<sup>21</sup> are hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, 5- to 7-membered cycloalkyl which may in turn bear C<sub>1</sub>-C<sub>10</sub>-alkyl groups as substituents, C<sub>6</sub>-C<sub>15</sub>-aryl or arylalkyl, where two adjacent radicals may together form a saturated or unsaturated cyclic group having from 4 to 15 carbon atoms, or Si(R<sup>24</sup>)<sub>3</sub> where

5 R<sup>24</sup> is C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>3</sub>-C<sub>10</sub>-cycloalkyl or C<sub>6</sub>-C<sub>15</sub>-aryl and

10 Z is as defined for X or is



20 where the radicals

25 R<sup>25</sup> to R<sup>29</sup> are hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, 5- to 7-membered cycloalkyl which may in turn bear C<sub>1</sub>-C<sub>10</sub>-alkyl groups as substituents, C<sub>6</sub>-C<sub>15</sub>-aryl or arylalkyl, where two adjacent radicals may together form a saturated or unsaturated cyclic group having from 4 to 15 carbon atoms, or Si(R<sup>30</sup>)<sub>3</sub> where

30 R<sup>30</sup> is C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>3</sub>-C<sub>10</sub>-cycloalkyl or C<sub>6</sub>-C<sub>15</sub>-aryl,

35 or the radicals R<sup>20</sup> and Z together form an -R<sup>31</sup>-A- group where

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$$R^{31} \text{ is } — M^1 — , — M^1 — M^1 — , — M^1 — CR_2^{34} —$$

R<sup>32</sup>                    R<sup>32</sup>                    R<sup>32</sup>                    R<sup>32</sup>  
 |                            |                            |                            |  
 |                            |                            |                            |  
 p<sup>33</sup>                    p<sup>33</sup>                    p<sup>33</sup>                    R<sup>33</sup>

$\begin{array}{c} \text{R}^{32} \\ | \\ \text{--- C ---} \\ | \\ \text{p}^{33} \end{array}$ 
,
 $\begin{array}{c} \text{R}^{32} \\ | \\ \text{--- O --- M}^1 \\ | \\ \text{p}^{33} \end{array}$ 
,
 $\begin{array}{c} \text{R}^{32} \\ | \\ \text{--- C --- C} \\ | \\ \text{p}^{33} \end{array}$

$$= \text{BR}^{32}, = \text{AlR}^{32}, -\text{Ge}-, -\text{Sn}-, -\text{O}-, -\text{S}-, = \text{SO}, \\ = \text{SO}_2, = \text{NR}^{32}, = \text{CO}, = \text{PR}^{32} \text{ or } = \text{P(O)R}^{32},$$

where

20 R<sup>32</sup>, R<sup>33</sup> and R<sup>34</sup> are identical or different and are each a hydrogen atom, a halogen atom, a C<sub>1</sub>-C<sub>10</sub>-alkyl group, a C<sub>1</sub>-C<sub>10</sub>-fluoroalkyl group, a C<sub>6</sub>-C<sub>10</sub>-fluoroaryl group, a C<sub>6</sub>-C<sub>10</sub>-aryl group, a C<sub>1</sub>-C<sub>10</sub>-alkoxy group, a C<sub>2</sub>-C<sub>10</sub>-alkenyl group, a C<sub>7</sub>-C<sub>40</sub>-arylalkyl group, a C<sub>8</sub>-C<sub>40</sub>-arylklenyl group or a C<sub>7</sub>-C<sub>40</sub>-alkylaryl group or two adjacent radicals together with the atoms connecting them form a saturated or unsaturated ring having from 4 to 15 carbon atoms, and

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$M^1$  is silicon, germanium or tin,

A is —O—, —S—,  $\text{NR}^{35}$  or  $\text{PR}^{35}$ ,

where

**40** R<sup>35</sup> is C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl, C<sub>3</sub>-C<sub>10</sub>-cycloalkyl,  
C<sub>7</sub>-C<sub>18</sub>-alkylaryl or Si(R<sup>36</sup>)<sub>3</sub>, where

R<sup>36</sup> is hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl which may in turn bear C<sub>1</sub>-C<sub>4</sub>-alkyl groups as substituents or C<sub>3</sub>-C<sub>10</sub>-cycloalkyl,

45 or the radicals R<sup>20</sup> and R<sup>28</sup> together form an -R<sup>31</sup>- group

and

C) is at least one compound capable of forming metallocenium ions.

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2. A supported catalyst as claimed in claim 1, wherein the monomer units III are compounds of the formula (IIIa),

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where

20 R<sup>8</sup> to R<sup>12</sup> are hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, 5- to 7-membered cycloalkyl which may in turn bear C<sub>1</sub>-C<sub>10</sub>-alkyl groups as substituents, C<sub>6</sub>-C<sub>15</sub>-aryl or arylalkyl, or

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the radicals may together with adjacent radicals in each case form a saturated or unsaturated ring having from 5 to 15 carbon atoms,

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but at least one radical R<sup>8</sup> to R<sup>12</sup> is a group of the formula (IV),

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where

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R<sup>13</sup> are identical or different and are each hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl or substituted or unsubstituted phenyl,

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q is an integer from 0 to 8 and

A<sup>2</sup>

is a group OR<sup>14</sup>, NR<sup>14</sup>R<sup>15</sup>, PR<sup>14</sup>R<sup>15</sup>, CN, COOR<sup>14</sup> or (O-(CH<sub>2</sub>)<sub>q</sub>)-OR<sup>14</sup>, where R<sup>14</sup> and R<sup>15</sup> are identical or different and are each hydrogen or C<sub>1</sub>-C<sub>4</sub>-alkyl and q' is an integer from 1 to 5 and q'' is an integer from 1 to 8,

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or the monomer units III are compounds of the formula (IIIb),

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(IIIb)

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A<sup>3</sup> is COOR<sup>16</sup> or CN, where

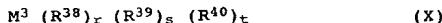
R<sup>16</sup> is hydrogen or C<sub>1</sub>-C<sub>10</sub>-alkyl.

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3. A supported catalyst as claimed in claim 1 or 2, wherein the copolymer A) is crosslinked via the monomer units II.

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4. A supported catalyst as claimed in any of claims 1 to 3 which further comprises, as additional component D), one or more metal compounds which are different from C) and have the formula (X)



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where

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M<sup>3</sup> is an alkali metal, an alkaline earth metal or a metal of main group III of the Periodic Table, i.e. boron, aluminum, gallium, indium or thallium,

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R<sup>38</sup> is hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl, alkylaryl or arylalkyl each having from 1 to 10 carbon atoms in the alkyl radical and from 6 to 20 carbon atoms in the aryl radical,

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R<sup>39</sup> and R<sup>40</sup> are hydrogen, halogen, C<sub>1</sub>-C<sub>10</sub>-alkyl, C<sub>6</sub>-C<sub>15</sub>-aryl, alkylaryl, arylalkyl or alkoxy each having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part,

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r        is an integer from 1 to 3

and

5        s and t        are integers from 0 to 2, where the sum r+s+t  
corresponds to the valence of M<sup>3</sup>.

5. A supported catalyst as claimed in claim 4, wherein the  
copolymer A) serving as support material has been pretreated  
10 with compounds of the formula (X) prior to application of  
metallocene complex B) and compound C) capable of forming  
metallocenium ions.

6. A process for preparing supported catalysts as claimed in any  
15 of claims 1 to 5, which comprises preparing copolymers  
comprising the monomer units I, II and III in solution or  
dissolving the copolymers in a suitable solvent after they  
have been prepared and adding the metallocene complex B) and  
20 the compound C) capable of forming metallocenium ions to this  
solution.

7. A process for preparing supported catalysts as claimed in  
claim 6, wherein the copolymer A) is crosslinked at from 0 to  
25 150°C by means of a Diels-Alder reaction either before or  
after the addition of metallocene complex B) and compound C)  
capable of forming metallocenium ions.

8. A process for preparing supported catalysts as claimed in  
claim 6 or 7, wherein the copolymer A) is pretreated with  
30 compounds of the formula (X) prior to the addition of  
metallocene complex B) and compound C) capable of forming  
metallocenium ions.

9. A copolymer which comprises the monomer units I, II and IIIA  
35 and is suitable as support material for catalysts for the  
polymerization of olefins.

10. A process for the polymerization of olefins in the presence  
of a supported catalyst as claimed in any of claims 1 to 5.

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## Supported catalyst for olefin polymerization

### Abstract

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A supported catalyst for olefin polymerization comprises

A) as support material, a copolymer comprising the monomer units I, II and III.

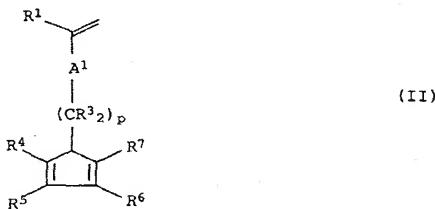
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where the monomer units I have the formula (I) and the monomer units II have the formula (II),

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where the variables have the following meanings:

$R^1$  is hydrogen,  $C_1-C_4$ -alkyl or phenyl.

35

R<sup>2</sup> is substituted or unsubstituted aryl or branched or unbranched alkyl or alkenyl.

A<sup>1</sup> is a direct chemical bond or a substituted or unsubstituted phenylene group.

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R<sup>j</sup> are identical or different and are each hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl or substituted or unsubstituted phenyl.

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R<sup>4</sup> to R<sup>7</sup> are hydrogen, C<sub>1</sub>-C<sub>10</sub>-alkyl or substituted or unsubstituted phenyl,

and the monomer units III have polar groups,

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and

B) at least one metallocene complex and

10 C) at least one compound capable of forming metallocenium ions.

A process for preparing such supported catalysts, copolymers suitable as support material and a process for the polymerization of olefins in the presence of a catalyst according to the present  
15 invention are also provided.

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